1. DEFINITIONS

In the specification, the following words and expression shall have the meanings assigned to them hereunder except where the context otherwise requires:

AEROTHAI	Aeronaultical Radio of Thailand Ltd.
ICAO Annex 10 Vol. I	Aeronaultical Telecommunications : Volume I Radio Navigation Aids. Sixth Edition, July 2006, Amendments 85
ICAO Annex 14 Vol. I	Aerodromes : Volume I Aerodrome Design and Operations. Fifth Edition, July 2009
ICAO Doc 8071 Vol. I	Manual on Testing of Radio Navigation Aids : Volume I Testing of Ground-Based Radio Navigation Systems. Fourth Edition – 2000
ICAO Doc 9157	Aerodrome Design Manual Part 6 Frangibility First Edition – 2006

2. GENERAL REQUIREMENTS

2.1 Three (3) DVOR/DME Systems shall be installed to replace the current system at Hat Yai Intl. Airport, Phrae Airport and Chum Phae Station.

2.2 The DVOR/DME System shall be designed based on dual transmitters and dual monitors configuration which consists of the following:

2.2.1 Dual DVOR equipment;

2.2.2 Dual DME equipment;

2.2.3 Antenna Systems for the above equipment;

2.2.4 Status indicator for each equipment specified in 2.2.1 and 2.2.2 which shall be equipped at control points;

2.2.5 Remote control equipment for each equipment specified in 2.2.1 and 2.2.3 which shall be equipped at technical room;

2.2.6 Remote maintenance and monitoring equipment for each equipment specified in 2.2.1 and 2.2.3 which shall be equipped at technical room.

2.3 The system performance and signal quality shall at least complied with the ICAO Annex 10 Vol. I.

2.4 All RF Generators shall be synthesizers.

2.5 The DVOR/DME System shall be designed based on modular technology, or an easy plug – in card or modules for the purpose of quick and easy replacement, maintenance and repair.

2.6 The transmitters shall be provided in dual and independent which housed in the cabinet (s) and operated as main and standby facilities. Maintenance on any one equipment shall be accomplished without disruption the operation of the others.

2.7 The equipment shall be designed in common of modules and printed circuit boards.

2.8 The equipment shall be designed for high–reliability operation and submitted with the purposed for Reliability analysis (MTBF,MTBO etc.) of all assemblies for DVOR/DME System.

2.9 The DME equipment shall be installed in co–location with the DVOR equipment.

2.10 All outdoor materials shall be suitably weather protected by appropriate coat or high grade paint in order to withstand severe ambient conditions of outdoor installation due to temperature, humidity, rainfalls, as specified in ICAO Annex 14 Vol. I.

2.11 Transmission lines, Cables and Accessories

2.11.1 All transmission lines, AC power lines and accessories shall be provided.

2.11.2 All buried cables shall be provided with underground–type and fitted in HDPE or RSC pipes which the inner diameter shall at least wide enough for fitting all cables easily.

2.11.3 All transmission lines and AC power lines shall be installed in a seperated HDPE or RSC pipes.

2.11.4 The underground cable work shall be done by the Contractor. The trench for lying underground cable shall be dug with more than fifty (50) cms in depth from ground surface and not less than thirty (30) cms in width. The trench basement shall be covered with twenty (20) cms thick of sand which is the base of underground cable. Finally, the underground cable shall be covered with twenty (20) cms thick of sand topping with twenty (20) cms thick of soil.

2.11.5 Cable route markers shall be provided and installed at every 10 meters for indicating

underground cables. The cable route marker specifications are detailed in section 2.

2.11.6 The Contractor shall take all responsible precautions to protect existing underground equipment and utilities. All known power and control cables leading to the facility shall be marked out by the Contractor with the aid of AEROTHAI personnel.

2.11.7 Test cables and accessories required for initial set up and maintenance shall be provided.

2.12 Power Supply

2.12.1 The DVOR/DME System and all peripheral equipments shall be operated with 220 ± 10 VAC, 50 Hz ± 5% single phase.

2.12.2 The UPS for the DVOR/DME System shall be provided and shall be installed at the Site.

2.12.3 Surge and Lightning Arrester unit with indicator for the power supply of each station shall be provided and installed at the site. The units shall provide a maintenance free service and bypass the energy from direct lightning strike to the incoming power line without interrupt of power supply. The units shall include indicator lamps to indicate failure of the lightning arresters. Type, model and diagram shall be submitted in the Proposal.

2.12.4 At the minimum, Surge and Lightning Arrester shall be provided as follow:

2.12.4.1 Maximum Continuous Operating Voltage (Uc) at least 320 VAC;

2.12.4.2 Voltage Protection Level (Up) less than 1.5 KV;

2.12.4.3 Maximum Discharge Current (Imax) (8/20 μs) at least 100 KA.

2.13 Operating Environment

2.13.1 Indoor equipment shall be designed for continuous operation under ambient temperature range of 5 °C to 50 °C with a relative humidity of up to 90%.

2.13.2 Outdoor equipment shall be designed for continuous operation under the temperature from 0 °C to 60 °C with up to 100% humidity of rain and more than 60 mph. wind velocity.

2.14 The grounding system shall be provided where the total resistance shall not exceed 5 Ω.

3. DOPPLER VHF OMNI RANGE (DVOR) EQUIPMENT

3.1 System Accuracy

3.1.1 Azimuth accuracy shall be better than ± 1 degree on ground measurement.

3.1.2 Azimuth stability shall be better than ± 0.5 degree measured at a monitor.

3.2 The dual DVOR equipment shall comprise, but not limited to:

3.2.1 Dual carrier transmitters;

3.2.2 Dual sideband transmitters;

3.2.3 Dual monitors;

3.2.4 DVOR test generator;

3.2.5 Antenna Switching Unit;

3.2.6 Antenna System.

3.3 Carrier Transmitter

3.3.1	Frequency band		– 111.975 to 117.975 MHz.
3.3.2	Operating frequency		– 115.3 MHz. for Hat Yai intl. Airport
			– 111.8 MHz. for Phrae Airport
			– 112.9 MHz. for Chum Phae Station
3.3.3	Frequency stability		– ± 0.002% from the operating frequency
3.3.4	Output power		– at least 50 watts (adjustable)
3.3.5	Spurious output		– better than 60 dB below carrier
3.3.6	Carrier modulation:		
	3.3.6.1	Reference frequency	– 30 Hz ± 0.2%
	3.3.6.2	Modulation depth	– 30% (adjustable)
	3.3.6.3	Identification frequency	– 1020 Hz ± 50 Hz
	3.3.6.4	Identification modulation depth	– 10% (adjustable)
	3.3.6.5	Speech channel filter	– band pass at the range of 300 to 3,000 Hz within 3 dB relative to the

level at 1,000 Hz

3.3.6.6 Speech modulation depth – up to 30%(the transmission of speech shall not interfere in any way with basic navigation function) (adjustable)

3.3.7 The Identification unit shall be able to generate any three letters International Morse Code for both DVOR and DME equipment.

3.3.8 The setting up of DVOR Identification code shall be computerized.

3.3.9 The DME Identification shall be generated on every forth DVOR Identification cycle.

3.3.10 Protection shall be provided for the RF amplifier from damage caused by open or short circuit of the output.

3.3.11 Thruline body and plug-in element shall be equipped for all radiating power output of the tranmitters. Type, model and diagram shall be submitted in the Proposal.

3.4 Sideband Transmitter

3.4.1 A double-sideband DVOR equipment shall be provided.

3.4.2 The Sub-carrier modulation mid-frequency shall be 9960 Hz ± 1%.

3.4.3 Phase control circuit shall maintain phase stability between the Sidebands and carrier signals.

3.4.4 Thruline body and plug-in elements shall be equipped for each sideband output. Type, model and diagram shall be submitted in the Proposal.

3.5 Monitor

3.5.1 The DVOR Monitor system shall be capable continuous monitoring fault (s) detection and producing alarm signal (s) for the following conditions occurs:

3.5.1.1 A change in excess of 1 degree of the bearing information transmitted by the DVOR equipment;

3.5.1.2 Reference signal 30 Hz modulation depth exceeds ± 2% from the nominal value;

3.5.1.3 Sub-carrier 9960 Hz modulation depth exceeds ± 2% from the nominal value;

3.5.1.4 Sub-carrier 9960 Hz deviation ratio exceeds 16 ± 1.

3.5.2 The bearing alarm limit shall be adjustable within ± 2 degrees with the step of not more than 0.1 degree.

3.5.3 The carrier RF level alarm limit shall be adjustable when the carrier level decreases 10% to 30% from the nominal value.

3.5.4 The identification alarm shall be provided for the following conditions:

3.5.4.1 Continuous keyed;

3.5.4.2 Loss of identification for more than 15 second (adjustable).

3.5.5 The Monitors shall be configurable such that both monitors are monitoring the operating (on-antenna) or standby (on-dummy) transmitter simultaneously.

3.5.6 When two Monitors are monitoring the operating transmitter, the Monitors can be configured either in 'AND' mode or 'OR' mode for a changeover or shutdown in the event of failure.

3.5.7 The Monitor shall provide a maintenance warning alarm to permit corrective action before an out-of-tolerance condition occurs. The warning indication shall be displayed at the designated control points and Remote Control and Status Unit (RCSU)

3.5.8 Alarm delay shall be adjustable.

3.5.9 Alarm history shall be provided to identify the parameter that has deviated beyond the alarm limit and caused the alarm.

3.5.10 The parameters of DVOR Transmitter and Monitor shall be provided and show on display. Control and Selection for display of those parameters shall be done by computerization which is permanently located at site. The following parameters, including but not limited to, shall be available:

3.5.10.1 The bearing information;

3.5.10.2 Reference signal 30 Hz modulation depth;

3.5.10.3 Sub-carrier 9960 Hz modulation depth;

3.5.10.4 Sub-carrier 9960 Hz deviation ratio;

3.5.10.5 Identification;

3.5.10.6 Forward and reflected power or standing wave ratio.

3.5.11 The field Monitor (including the Monitor antenna, the Antenna mast, transmission lines, obstruction lighting) for monitoring the radiated composite signal shall be provided for installation at any azimuth suitable for installation. Type, and model shall be submitted in the Proposal.

3.5.12 Double LED obstruction lighting with photo-switch shall be installed with the monitor antenna which conforms with the ICAO Annex 14 Vol. I Chapter 6 – Visual Aids For Denoting Obstacles and Federal Aviation Administration (FAA) Specification for Obstruction Lighting Equipment (AC 150/5345-43F OR 43G). Type and model shall be submitted in the Proposal.

3.6 Test Generator

3.6.1 The Test Generator for DVOR equipment shall be able to check and calibrate the monitor to conform with ICAO Annex 10 Vol. I.

3.6.2 Type and model of the Test Generator shall be submitted in the Proposal (in case of separated unit).

3.6.3 Built-in-Test (BIT) or Fault Diagnostics shall be provided for all Lowest Replaceable Units (LRU) and capable of being initiated locally and remotely.

3.7 Antenna Switching

3.7.1 The RF Power Distributor in the Antenna Switching unit shall be broadband for operation in the range of 108 to 118 MHz.

3.7.2 Surge and Lightning Arresters shall be provided for all output ports of the distributor.

3.8 Antenna System

3.8.1 The operating frequency of each Antenna element shall be adjusted from thee factory.

3.8.2 The Proposal shall describe the method of sideband feed lines fabrication and any other adjustment procedures.

3.8.3 The Antenna VSWR shall not exceed 1.2 : 1 for carrier and 1.2 : 1 for sideband.

3.8.4 The Antenna System shall provide sufficient coverage as required in ICAO Annex 10 Vol. I Paragraph 3.3.4 except where topographical features are dictated.

4. DISTANCE MEASURING EQUIPMENT (DME)

4.1 The DME equipment shall comprise:

4.1.1 Dual transponders;

4.1.2 Dual monitors;

4.1.3 Antenna system.

4.2 Transponder

4.2.1 Frequency band – 960 to 1215 MHz.

4.2.2 Operating channel
- CH 100X for Hat Yai intl. Airport.
- CH 55X for Phrae Airport.
- CH 76X for Chum Phae Station.

4.2.3 Transmitter characteristics

4.2.3.1 The radio frequency of operation shall not vary more than plus or minus 0.002% from the assigned frequency.

4.2.3.2 Pulse shape and spectrum of pulse modulated signal shall meet the requirements for DME/N in ICAO Annex 10 Vol. I Paragraph 3.5.4.1.3.

4.2.3.3 Pulse spacing shall meet the requirements specified in ICAO Annex 10 Vol. I Paragraph 3.5.4.1.4.

4.2.3.4 The peak power of each pulse of any pulse pair shall not differ by more than 1 dB.

4.2.3.5 Peak effective radiation power of the reply pulse shall not be less than 30 dBw.

4.2.3.6 The transponder power amplifier shall provide full output power of not less than 1000 watts to the antenna.

4.2.4 Receiver characteristics

4.2.4.1 The centre frequency of the receiver shall not vary more than plus or

minus 0.002% from the assigned frequency.

4.2.4.2 Transponder sensitivity shall meet the requirements specified in ICAO Annex 10 Vol. I Paragraph 3.5.4.2.3.

4.2.4.3 Bandwidth and selectivity shall meet the requirements specified in ICAO Annex 10 Vol. I Paragraph 3.5.4.2.6.

4.2.4.4 CW and echo suppression shall be provided and meet the requirements specified in ICAO Annex 10 Vol. I Paragraph 3.5.4.2.9.

4.2.5 Video

4.2.5.1 Interrogating pulse spacing error more than ± 2 microseconds shall be rejected.

4.2.5.2 Receiver dead time shall be adjustable for echo suppression as measured after main delay time.

4.2.5.3 Long distance echo suppressor shall be provided by automatic receiver gain reduction according to each echo pulse level.

4.2.5.4 The minimum transmission rate shall be as close as practicable to 700 PPS.

4.2.5.5 The maximum transmission rate shall be at least 4,800 PPS.

4.2.5.6 Identification shall meet the requirements specified in ICAO Annex 10 Vol. I Paragraph 3.5.3.6 for association with the DVOR identification.

4.2.5.7 The time delay shall meet the requirements specified for DME/N in ICAO Annex 10 Vol. I Paragraph 3.5.4.4.

4.2.5.8 Reply delay, pulse spacing and pulse width shall be adjustable to the specified values without removing any module from the assembly.

4.3 Monitor

4.3.1 The Monitor shall serve two purposes.

4.3.1.1 To ensure that the transponder signal is within the tolerance as specified for DME/N in ICAO Annex 10 Vol. I Paragraph 3.5.4.

4.3.1.2 To be used as a RF signal generator in conjunction with a built-in test unit for calibration, testing and maintenance of the transponder.

4.3.2 The Monitor shall initiate an alarm signal if any of the following conditions occurs:

4.3.2.1 Reply delay error exceed 1 microsecond;

4.3.2.2 Transmitting pulse spacing error exceed 1 microsecond;

4.3.2.3 Reply efficiency is less than 70%;

4.3.2.4 Effective radiated power (ERP) decreases below by 3 dB;

4.3.2.5 Transmitting pulse count falls below 700 PPS;

4.3.2.6 Continuous or loss of identification.

4.3.3 The occurrence of primary alarm shall initiate a transfer action while the main transponder is operating (on–antenna) and a shutdown action while the standby transponder is operating (on–antenna). The primary alarms are generated by reply delay error (in 4.3.2.1) or transmitting pulse spacing error (in 4.3.2.2).

4.3.4 The occurrence of secondary alarm shall initiate a transfer action while the main transponder is operating (on–antenna). The secondary alarms are generated by conditions in 4.3.2.3 – 4.3.2.6.

4.3.5 The Monitors shall be configurable such that both monitors are monitoring the operating (on–antenna) and standby (on–dummy) transponder simultaneously.

4.3.6 When two Monitors are monitoring the operating transponder, the monitors can be configured either in 'AND' mode or 'OR' mode for a changeover or shutdown in the event of failure.

4.3.7 Alarm history shall be provided to identify the parameter that has deviated beyond the alarm limit and caused the alarm.

4.3.8 Monitor signal generator output shall be selected so that the channel frequency deviation of ± 200 KHz. and ± 900 KHz. of the transponder receiver can be tested.

4.3.9 Monitor signal generator output level shall be adjustable from –94 dBm to –25 dBm or wider.

4.3.10 Monitor PRF shall be adjustable from 700 to 4,800 PPS.

4.3.11 At least the following Transponder and Monitor parameters shall be available for display at the designated control points:

4.3.11.1 Reply delay;

4.3.11.2 Reply pulse pair spacing;

4.3.11.3 Reply efficiency;

4.3.11.4 Transmit power;

4.3.11.5 Transmitter pulse count;

4.3.11.6 Identification.

4.3.12 Control and selection for display of the Transponder and Monitor parameters in 4.3.11 shall be done by a Desktop or Notebook Computer which is permanently located at the Site.

4.4 Antenna System

4.4.1 The Antenna shall be an Omni-directional antenna type.

4.4.2 The Antenna shall be capable of radiating DME signal throughout the DME frequency band (960 to 1,215 MHz) so that changing of the operating frequency needs no re-adjustment of the Antenna.

4.4.3 The Antenna system shall provide sufficient coverage as required in ICAO Annex 10 Vol. I Paragraph 3.5.3.1.2.1 except for where topographical features dictate.

4.4.4 The radiation patterns of the Antenna System shall be submitted with the Tender.

4.4.5 Double LED obstruction lighting with photo-switch shall be installed with the antenna which conforms with the ICAO Annex 14 Vol. I Chapter 6 – Visual Aids For Denoting Obstacles and Federal Aviation Administration (FAA) Specification for Obstruction Lighting Equipment (AC150/5345-43F OR 43G). Type and model shall be submitted in the Proposal.

5. CONTROL AND MONITORING

5.1 DVOR Local Control Unit

5.1.1 The front-panel control unit with indicators shall be at least capable of :

5.1.1.1 Selecting the main equipment from the front-panel switch;

5.1.1.2 Turning on the standby transmitter into dummy loads for testing purposes;

5.1.1.3 Bypassing the monitor;

5.1.1.4 Selecting Remote/Local Control;

5.1.1.5 Resetting the alarm;

5.1.1.6 Shutting down the station;

5.1.1.7 Displaying operating status of the equipment.

5.1.2 The Local Control Unit shall be able to adjust and display transmitter and monitor parameters via a Desktop Computer which is permanently located at site.

5.1.3 Three (3) sets of Desktop Computer shall be provided as part of the Local Control Unit for DVOR. The Desktop Computer for DVOR shall be provided separately from the Desktop Computer for DME. The Desktop Computer Specifications are specified in clause 10.

5.1.4 The software for monitoring and controlling the DVOR equipment shall be installed in the Desktop Computer. The recovery CD/DVD for the software shall be provided. The user's license for the software shall be provided for AEROTHAI.

5.2 DME Local Control Unit

5.2.1 The front-panel control unit with indicators shall be at least capable of:

5.2.1.1 Selecting the main equipment from the front-panel switch;

5.2.1.2 Turning on the standby transponder into dummy loads for testing purposes;

5.2.1.3 Bypassing the monitor;

5.2.1.4 Selecting Remote/Local control;

5.2.1.5 Resetting the alarm;

5.2.1.6 Shutting down the station;

5.2.1.7 Displaying the operating status of the equipment.

5.2.2 The Local Control Unit shall be able to adjust and display transponder and monitor parameters via a Desktop Computer which is permanently located at Site.

5.2.3 Three (3) sets of Desktop Computer shall be provided as part of the Local Control Unit for DME. The Desktop Computer for DME shall be provided separately from the Desktop Computer for DVOR. The Desktop Computer Specifications are specified in

clause 10.

5.2.4 The software for monitoring and controlling the DME equipment shall be installed in the Desktop Computer. The recovery CD/DVD for the software shall be provided. The user's license for the software shall be provided for AEROTHAI.

5.3 Remote Control and Status Unit (RCSU)

5.3.1 The DVOR/DME RCSU shall have at least the following control and monitoring functions:

5.3.1.1 Turn on/off the selected transmitter/transponder with indicator;

5.3.1.2 Transfer and shutdown with indicator;

5.3.1.3 NORMAL/ALARM indicator and audible alarm;

5.3.1.4 Alarm silence control with indicator;

5.3.1.5 Station alarm reset.

5.3.2 The Remote Control Equipment shall be housed in a cabinet suitable for either desktop or rack at the technical room.

5.3.3 RCSU shall be connected via land line (provided by AEROTHAI) and the outdoor wireless link (5.150–5.850 GHz) (provided by the Contractor).

5.3.4 The wireless link between the DVOR/DME site and the technical room for the RCSU shall be installed. The wireless link specification is specified in clause 6.3

5.3.5 The selection capability for using the land line or the outdoor wireless link as the main communication link between DVOR/DME equipment and the technical room shall be provided.

5.3.6 Surge and lightning protection shall be provided at both ends of land line and the outdoor wireless link. Type, model and diagram shall be submitted in the Proposal.

5.4 Remote Status Unit (RSU)

5.4.1 The status indicator with audible alarm suitable for installation in the control tower shall be provided.

5.4.2 The RSU shall have at least the following features:

5.4.2.1 Display the operating status of the DVOR/DME;

5.4.2.2 Visual and audible alarm with an alarm silence control;

5.4.2.3 Turn on/off switch for the RSU.

5.4.3 The unit shall be installed to console for usage of an air traffic controller at the control tower.

5.5 Remote Monitoring and Maintenance (RMM)

5.5.1 The RMM shall monitor and control DVOR/DME equipment public telephone network.

5.5.2 The RMM shall have at least the following functionalities for each equipment:

5.5.2.1 Selecting the main/standby;

5.5.2.2 Turning on the standby transmitter/transponder into dummy loads for testing purposes;

5.5.2.3 Bypassing the monitor;

5.5.2.4 Resetting the alarm;

5.5.2.5 Shutting down the station;

5.5.2.6 Adjusting and displaying transmitter / transponder and monitor parameters.

5.5.3 The RMM shall be interfaced with a PABX to DVOR/DME site via land line (provided by AEROTHAI) and the outdoor wireless link (5.150 –5.850 GHz) (provided by the Contractor).

5.5.4 The communication for the RMM must be separated from that for the RCSU for redundancy.

5.5.5 The wireless link between the DVOR/DME sites and the technical room for the RMM shall be installed. The operating frequency of the wireless link shall be adjustable within the band UHF 5.150–5.850 GHz by users. The air link shall be at least AES 128 bits encryption.

5.5.6 Surge and Lightning protection shall be provided at both ends of the Land line and the outdoor wireless link. Type, model and diagram of the Surge and Lighting protection shall be submitted in the Proposal.

5.5.7 The RMM shall be performed from a Notebook Computer or a Desktop Computer.

5.5.8 Three (3) sets of Desktop Computer shall be provided as part of the RMM located at technical room. Brand and model shall be submitted in the Proposal. The Desktop Computer Specifications are specified in clause 10.

5.5.9 Three (3) sets of Notebook Computer shall be provided as part of the RMM. Brand and model shall be submitted in the Proposal. The Notebook Computer Specifications are specified in clause 11.

5.5.10 The RMM software for monitoring and controlling the DVOR/DME equipment from anywhere shall be installed in the Notebook Computer and the Desktop Computer. The recovery CD/DVD for the RMM software shall be provided. The user's license for the software shall be provided for AEROTHAI.

5.5.11 Three (3) sets of Laser color printer for hard copy report of the station status and meter reading shall be provided as part of the RMM located at technical room.

6. SUPPLEMENTS

6.1 Portable Navigational Signal Analyzer (PNSA)

6.1.1 Three (3) sets of Portable Navigational Signal Analyzer shall be provided. They shall be used for ground test of the ILS, VOR and Marker beacon. Each PNSA shall comprises:

6.1.1.1 Receiver for Localizer, Glide Slope, VOR and Marker Beacon;

6.1.1.2 Built–in rechargeable battery;

6.1.1.3 Antennas for Localizer, Glide Slope and VOR;

6.1.1.4 Battery Charger;

6.1.1.5 Antenna Pole;

6.1.1.6 Accessories.

6.1.2 The PNSA shall be designed for outdoor purpose with compact, weatherproof and total weight shall not exceed 5 kilograms.

6.1.3 All ILS/VOR channels shall be selectable.

6.1.4 Performance analyzer of ILS Localizer, Glide Slope, Marker Beacon and VOR shall be performed in accordance with ICAO Doc 8071 Vol. I.

6.1.5 All parameters shall be printed directly via RS 232 and USB port if available.

6.1.6 PNSA shall be provided real time measurement data directly via RS 232 C.

6.1.7 PNSA shall be provided Interface Control Document (ICD) for extracting or decoding the real time measurement data.

6.1.8 Battery charger shall be operated on 220 VAC 50 Hz.

6.2 Portable Vector Network Analyzer (PVNA)

6.2.1 Two (2) sets of Portable Vector Network Analyzer (PVNA) equipment shall be provided.

6.2.2 General Requirements

6.2.2.1 The PVNA equipment shall be able to perform the following functions: Vector Network Analyzer (VNA), Vector Volt Meter, Spectrum Analyzer.

The PVNA equipment shall be able to analyze the test results from Transmission / Reflection Measurement, Return loss, VSWR, Cable loss, Distance to fault, Terminating Power Measurements, Spectrum Analysis, Smith Chart and shall be able to receive the Global Positioning Satellite (GPS) signal.

6.2.2.2 The PVNA equipment shall be designed for outdoor purpose with compact, weatherproof and the total weight shall not exceed 5 kilograms.

6.2.2.3 The equipment shall be equipped with full two (2) Vector Network Analyzer Measurement ports, internal memory and USB Ports.

6.2.3 Technical Requirements

6.2.3.1 Vector Network Analyzer specifications

6.2.3.1.1 Frequency

6.2.3.1.1.1 Frequency range : 100 KHz. to 5 GHz.

6.2.3.1.1.2 Frequency accuracy : ≤2 ppm

6.2.3.1.1.3 Frequency resolution : ≤ 10 Hz

6.2.3.1.1.4 Data points : capable of zoom in and zoom out signal shape

6.2.3.1.2 Transmission measurement

– Dynamic range : > 50 dB at 100 KHz. to 300 KHz.

: > 80 dB at 300 KHz. to 2.5 GHz.

: > 70 dB at 2.5 GHz. to 5 GHz.

6.2.3.1.3 Reflection measurement
– Directivity : > 30 dB at 100 KHz. to 5 GHz.

6.2.3.1.4 Maximum cable length for measurement : ≥ 500 m.

6.2.3.1.5 Measurement parameter : S11, S12, S21, S22

6.2.3.2 Spectrum Analyzer specifications

6.2.3.2.1 Frequency range : 200 kHz. to 6 GHz.

6.2.3.2.2 Maximum continuous Input (≥10 dB Attn) : ≥ 27 dBm

6.2.3.2.3 Frequency accuracy : ± 2 ppm

6.2.3.2.4 Frequency resolution : ≤ 1 Hz

6.2.3.2.5 Frequency reference aging : ±1 ppm/years

6.2.3.2.6 Frequency span : 10 Hz to 6 GHz. plus 0 Hz (zero span)

6.2.3.2.7 Resolution bandwidth (–3dB bandwidth) : 10 Hz to 3 MHz.

6.2.3.2.8 Video bandwidth (–3 dB bandwidth) : 1 Hz to 3 MHz.

6.2.3.2.9 Sweep time (span 0 Hz) : 200 µs to 100 s

6.2.3.2.10 Amplitude measurement range : DANL to + 20 dBm

6.2.3.2.11 Displayed Average Noise Level (DANL)
(DANL in 1 Hz RBW, 0 dB attenuation)

Frequency	Max (Preamp On)	Max (Preamp Off)
10 MHz to 6 GHz	< –149 dBm	< –130 dBm

6.2.3.2.12 Amplitude units : log scale modes dBm, dBmV, dBµV, V, W

6.2.3.2.13 Attenuator range : 0 to 30 dB

6.2.3.3 General specifications

6.2.3.3.1 The runtime of internal battery shall not less than 2 hours under full function usage condition.

6.2.3.3.2 Type N female RF connectors

6.2.3.3.3 Maximum damage input power : ≥ 20 dBm

6.2.3.3.4 Internal memory : ≥ 256 Traces

6.2.3.3.5 USB interface for transfer data

6.2.3.3.6 LAN Interface for remote control

6.2.3.3.7 AC power supply : 110 V – 220 V ± 10 %

6.2.3.3.8 Colour LCD displayed

6.2.3.3.9 Built–in internal speaker

6.2.3.3.10 Built–in GPS receiver and removable GPS antenna

6.2.3.3.11 Having an authorized representative in Thailand

6.2.4 Accessories

6.2.4.1	Rechargeable battery (Li–ion)	1 set
6.2.4.2	AC adapter/charger	1 set
6.2.4.3	Car charger	1 set
6.2.4.4	Software analysis and software control	1 set
6.2.4.5	Calibration kit	1 set
6.2.4.6	Adapter kits 50 Ω, (N–Type, SMA, TNC, BNC ฯ)	1 set
6.2.4.7	Test port cable DC–6 GHz, 50 Ω, N(m)–N(f)	1 set
6.2.4.8	Operation manual	2 sets
6.2.4.9	Service manual or maintenance manual	1 set
6.2.4.10	Soft carrying case	1 ea
6.2.4.11	Hard case (Factory Product)	1 ea

6.3 Wireless Link Radio Equipment

6.3.1 The wireless link between the DVOR/DME sites and the technical room for the RMM, RCSU shall be provided.

6.3.2 Radio

6.3.2.1 Frequency range : 5.150–5.850 GHz.

6.3.2.2 Channel bandwidth : ≥ 20 MHz.

6.3.3 Data communication

6.3.3.1 The air link shall be at least AES 128 bits encryption.

6.3.3.2 VLAN support : 802.1 q

6.3.3.3 Maximum throughput : ≥ 20 Mbps

6.3.4 Antenna & Transmission line

6.3.4.1 Antenna gain : ≥ 16dBi

6.3.4.2 The sufficient transmission line shall be provided.

6.4 DVOR Spare Parts

6.4.1 Six (6) sets of DVOR spare parts shall be provided.

6.4.2 One (1) set of DVOR spare parts in 6.4.1 shall consist of one complete unit of each line replaceable module (LRM), printed circuit boards (PCBs), backplanes, RF switches (Coaxial relays, RF distribution units) for DVOR.

6.5 DME Spare Parts

6.5.1 Six (6) sets of DME spare parts shall be provided.

6.5.2 One (1) set of DME spare parts in 6.5.1 shall consist of one complete unit of each line replaceable module (LRM), printed circuit boards (PCBs), backplanes, RF switches (Coaxial relays) for DME.

6.6 Wireless Link Equipment Spare Parts

Six (6) Wireless Link Equipments shall be provided as spare parts.

6.7 Double LED obstruction lighting Spare Parts (in clause 3.5.12 and 4.4.5)

Six (6) sets of Double LED obstruction lighting shall be provided as spare parts.

7. TOOLS AND MAINTENANCE AIDS

7.1 For system installation and hardware adjustment, tool kits and maintenance aids list as specified in **Appendix B** per DVOR/DME system shall be provided.

7.2 A suitable waveform analysis tool, thruline wattmeter and digital multimeter tool shall be provided, with functions including but not limited to, as specified in **Appendix B**.

7.3 Extension cables and cards as required for each module/ PCB of the DVOR/DME shall be provided for maintenance.

7.4 Test cables, dummy loads, attenuation kits for RF signal adjustment shall be provided.

7.5 Installation materials such as external and internal cablings, cable trays, connectors, cable ties, conduits shall be provided.

8. TECHNICAL DOCUMENTS AND TEST REPORTS

The Contractor shall provide the following drawings documents:

8.1 Six (6) sets, hard copy and CD/DVD, of mechanical and electrical DVOR/DME drawings essential for installation, maintenance and troubleshooting of the equipment, including such drawings as are needed to identify the components and cable within the equipment or its sub units;

8.2 Seven (7) sets, hard copy and CD/DVD, of DVOR/DME installation and equipment instruction manuals, setting out in detail the procedures for operation, routine maintenance, troubleshooting of the equipment, test and alignment procedures, including schematics and inter–cabling diagrams;

8.3 Six (6) sets of hard copy and CD/DVD for DVOR/DME component part lists which cludes manufacturer part numbers or descriptions of any generic component level devices (ICs, transistors, capacitors, etc.) in each Line Replaceable Modules (LRMs) shall be provided for the propose of comparing for the generic devices with electronic component in the market in order to repair the LRMs after the warranty period.

8.4 Three (3) original and Six (6) hard copies of Factory Acceptance Test (FAT) report shall be

provided at the factory after the completion of FAT.

8.5 Three (3) original and Six (6) hard copies of Functional Unit Test (FUT) report before commissioning flight check shall be provided at the site after the completion of FUT.

8.6 Three (3) original and Six (6) hard copies of Site Acceptance Test (SAT) report shall be provided at the site after the completion of the commissioning flight check.

9. UNINTERRUPTED POWER SUPPLY (UPS)

9.1 General Requirements

9.1.1 Three (3) sets of UPS shall be a **10–KVA** True On–Line Type with Double Conversion.

9.1.2 On–Line UPS including associated circuits for emergency used for the DVOR/DME equipment shall be capable of providing **backup time at least 3 hours**.

9.1.3 The battery shall be continuously float charged. The battery charger shall be capable of charging batteries which are completely discharged.

9.1.4 The UPS shall be provided with protection against overcharging, overcurrent and short–circuit, spill proof, maintenance free and with capability of latching shutdown on overload.

9.1.5 In the event of a main failure, the battery shall automatically take over without any interruption the system operation.

9.1.6 When UPS failure or overload is occurred, Static Transfer Switch shall be able to automatically transfer the load supplied by the inverter to the reserve line without any interruption of the system operation.

9.1.7 In addition to clause 9.1.6 the Static Transfer Switch shall be able to automatically transfer the load supplied back to its previous operation without any interruption of the system operation when the UPS failure or overload are back to the normal state.

9.1.8 Manual bypass switch shall be provided for maintenance purpose. When the manual bypass switch is selected, the system shall be able to operate without any interruption.

9.1.9 The status of UPS including shall be displayed at the technical room. **The communication diagram between UPS at DVOR/DME site and technical room shall be submitted in the Proposal.**

9.1.10 Protection shall be provided against damage of semiconductors due to the battery polarity being inadvertently reversed.

9.2 Technical Requirements

9.2.1 Input

9.2.1.1 Voltage	: 220 VAC or 230 VAC ±15% or better
9.2.1.2 Frequency	: 50 Hz ±5% or better
9.2.1.3 Phase	: Single (2 Wire + Ground)

9.2.2 Output

9.2.2.1 Voltage	: 220 VAC or 230 VAC ±15% or better
9.2.2.2 Frequency	: 50 Hz ±0.5% or better
9.2.2.3 Phase	: Single (2 Wire + Ground)
9.2.2.4 Wave Form	: Sine wave
9.2.2.5 Total harmonics distortion	: ≤ 3 % for 100% Linear Load
9.2.2.6 Overall efficiency	: ≥ 84% at load
9.2.2.7 AC to AC – Crest factor	: 3:1 or better

9.2.3 Overload capacity – 120% Load	: 1 Min or better

9.2.4 Environment

9.2.4.1 Ambient temperature	: 0–40 °C (Continuous) or better
9.2.4.2 Humidity	: 90% continuously with non–condensing

9.2.5 Audible noise	: ≤ 55 dB(A) at 1 m.

9.2.6 Battery

9.2.6.1 Type	: Maintenance free sealed lead acid
9.2.6.2 Discharge	: High rate discharge
9.2.6.3 Life time	: ≥ 4 years at 25° C
9.2.6.4 Back up time	: **≥ 3 hours at full load of UPS**

9.2.7 Status and Control Indicator the capability, including but not limited to, shall be as follows.

9.2.7.1 Display status and parameters, line input, inverter, output, load on bypass, battery and fault;

9.2.7.2 Provide visual and audible alarm when main fail, low battery and overload;

9.2.7.3 Enable and disable alarm.

10. DESKTOP COMPUTER

The Tenderers shall provide the Desktop Computer including all attached devices that are installed for system operation and monitoring. The Tenderers shall propose the technical specifications of Desktop Computer which comply with or is better than the following specifications.

10.1 Desktop, Display and Keyboard shall be produced form the same manufacturer with permanent logo/ brand on product.

10.2 Processor/ Chip set

10.2.1 3rd Generation Intel Core i5

10.2.2 Clock speed – 2.4 GHz.

10.3 RAM

10.3.1 Technology – DDR 3 SDRAM

10.3.2 Memory speed – 1066 MHz.

10.3.3 Size – 4.0 GB/ 8.0 GB (max)

10.4 One (1) Hard disk Drive

10.4.1 Capacity – 1.0 x 1.0 TB

10.4.2 Interface type – Serial ATA

10.5 One (1) Optical Storage

Internal DVD +/– RW Drive

10.6 Graphic Controller

Built–in with resolution 1280 x 1024 pixels

10.7 One (1) Display

17 inches LED

10.8 Networking

10.8.1 Built–in on board

10.8.2 10/100/1000 Mbps Ethernet

10.8.3 RJ-45 Interface type

10.9 Audio Output

Sound output including speakers

10.10 I/O Interfaces

10.10.1 Minimum 4 ports USB 2.0

10.10.2 1 Serial ports or 1 converted device for converting USB to Serial

10.11 Slots

1 expansion slot

10.12 One (1) Keyboard

10.12.1 Standard QWERTY keyboard with USB interface

10.12.2 104 keys at minimum

10.12.3 Each key shall be permanently printed with both Thai and English characters

10.13 One (1) Mouse

10.13.1 Optical Mouse with scroll wheel

10.13.2 USB interface

10.13.3 A suitable mouse pad

10.14 Operation System/ Software

10.14.1 Shall be installed with the Desktop Computer

10.14.2 Capable of operating with the software of the proposed DVOR/DME System

10.14.3 Recovery CD/DVD with a copy right shall be provided.

10.15 Compliant Standards

FCC or UL or CSA or ETL

10.16 The Operating System and License which is capable of operating the DVOR/DME System shall be provided.

10.17 One (1) set of Office table and chair which is suitable for computer operation shall be provided.

10.18 Manufacturer warranty for the Desktop Computer according to **clause 13** of the Tender Document shall be provided.

10.19 The Desktop Computer shall have a manufacturer branch office authorized representative in

Thailand.

10.20 The manufacture of the Desktop Computer shall receive ISO 9000 Series Certification.

10.21 The CD/DVD for software driver shall be provided with the product.

11. NOTEBOOK COMPUTER

The Tenderers shall provide the Notebook Computer including all attached devices that are installed for system operation and monitoring. The Tenderers shall propose the technical specifications of Notebook Computer which comply with or is better than the following specifications.

11.1 Processor/ Chip set

11.1.1 3rd Generation Intel Core i5

11.1.2 Clock speed – 2.4 GHz.

11.2 RAM

11.2.1 Technology – DDR 3 SDRAM

11.2.2 Memory speed – 1066 MHz.

11.2.3 Size – 4.0 GB/ 8.0 GB (max)

11.3 One (1) Hard disk Drive

11.3.1 Capacity – 1.0 x 500 GB

11.3.2 Interface type – Serial ATA

11.4 One (1) Optical Storage

Internal DVD +/– RW Drive

11.5 Graphic Controller

Minimum graphic card memory 512 MB GDDR 3

Support display resolution WXGA

11.6 Display

14 inches LED

11.7 Internal Wireless LAN

Standards 802.11 b/g/n

11.8 Modem

Minimum speed 56 Kbps

11.9 Network Interface

11.9.1 Built-in on board

11.9.2 10/100/1000 Mbps

11.10 Audio Output

Sound output including built-in speakers

11.11 I/O Interfaces

11.11.1 Three (3) ports USB 2.0

11.11.2 One (1) VGA port, One (1) Serial port or One (1) converted device for converting USB to Serial

11.12 Keyboard

Each key shall be permanently printed with both Thai and English characters

11.13 Mouse

11.13.1 Optical Mouse with scroll wheel

11.13.2 USB interface

11.13.3 A Suitable mouse pad

11.14 Pointing Device

Touch pad

11.15 Battery

6-Cell, Lithium Ion rechargeable

11.16 Operation System/ Software

11.16.1 Shall be installed with the Notebook Computer

11.16.2 Capable of operating with the software of the proposed DVOR/DME System

11.16.3 Recovery CD/DVD with a copy right shall be provided.

11.17 Compliant Standards

FCC or UL or CSA or ETL

11.18 The Operating System and License which is capable of operating the DVOR/DME System shall be provided.

11.19 The Notebook Computer shall have a manufacturer branch office authorized representative in Thailand.

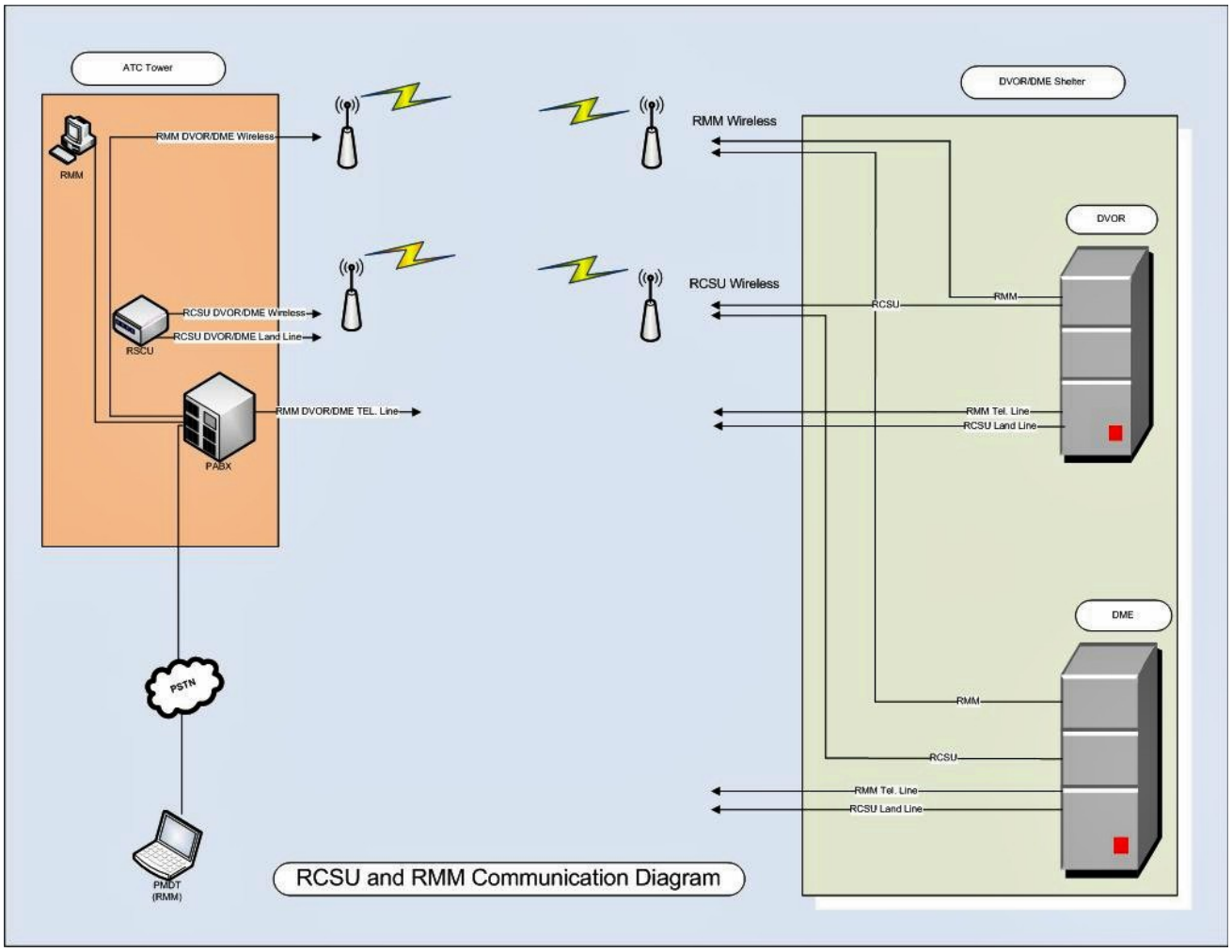
11.20 The manufacture of the Notebook Computer shall receive ISO 9000 Series Certification. Operating Manual and software driver CD or DVD shall be provided with the product.

11.21 One (1) 14 inches Notebook carrying case shall be provided with the Notebook Computer.

11.22 Maximum weight 2.5 Kilogram including battery.

11.23 Manufacturer warranty for the Notebook Computer according to **clause 13** of the Tender Document shall be provided.

12. RCSU and RMM Communication Diagram



APPENDIX A : LIST OF ABBREVIATIONS

Abbreviations	Full Name
°C	Degree Celsius
AC	Alternating Current
AEROTHAI	Aeronautical Radio of Thailand Ltd.
cms	Centimeters
CW	Continuous Wave
dB	Decibel
DDM	Difference in Depth of Modulation
DME	Distance Measuring Equipment
DVOR	Doppler Very High Frequency Omnidirectional Range
FAA	Federal Aviation Administration
GHz	Giga Hertz
GS	Glide Slope
Hz	Hertz
HDPE	High Density Polyethylene
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
ILS	Instrument Landing System
Imax	Maximum Discharge Current
KVA	Kilo Volt Amp

Kms	Kilometers
KHz	Kilo Hertz
MHz	Mega Hertz
MTBF	Mean Time Between Failure
MTBO	Mean Time Between Outage
mph	Mile per hour
µs	Microsecond
PABX	Private Automatic Branch Exchange
PCB	Printed Circuit Board
PMDT	Portable Maintenance Data Terminal
PNSA	Portable Navigational Signal Analyzer
PVNA	Portable Vector Network Analyzer
RCSU	Remote Control and Status Unit
RF	Radio Frequency
RSC	Ring Stiffness Constant
RSU	Remote Status Unit
RMM	Remote Monitoring and Maintenance
SDM	Sum in Depth of Modulation
Uc	Maximum Continuous Operating Voltage
Up	Voltage Protection Level
UHF	Ultra High Frequency

UPS	Uninterrupted Power Supply
USB	Universal Serial Bus
VAC	Voltage of Alternating Current
VOR	Very high frequency Omnidirectional Range

APPENDIX B : TOOLS AND MAINTENANCE AIDS

Tool	Functions at minimum
– Digital Multimeter	– True RMS voltage and current measurements – 6000 count resolution – Digital Display with analog bar graph – Manual and automatic ranging – DC basic Accuracy ±0.15%.
– Waveform analysis	– Band Width ≥ 60 MHz – Digital type 2 channel – LCD display – Sample rate on each channel 1.0 Giga Sampling/sec. – Vertical resolution 8 bits – Time base accuracy 50 part/million (ppm)
– Thruline Wattmeter with element	– Frequency band VHF 50–125 MHz – 100 milliwatt, 250 milliwatt, 1 watt, 25 watt, 50 watt. – Frequency band UHF 328–336 MHz – 100 milliwatt, 250 milliwatt, 1 watt, 5 watt.

–Tool kits	– Alignment tools (2) – Bumisher (pkg./3) – DIP/IC extractor – Feeler gauge – File kit, (3 pc.) – Hammer, ball peen, 4 oz. – Handle, driver blades (2):4–1/8″, ″T″ – Handle, File – Hemostat, straight, 5″ – Hexdriver blades (9): .050, 1/16, 5/64, 3/32, 7/64, 1/8, 9/64, 5/32, 3/16″ – Hex key set, (10 pc.) – Hex key fold up (7): 2–8 mm – Knife precision – Knife blades – Mirror, inspection – Nutdriver blades (9): 3/16, 7/32, 1/4, 9/32, 5/16, 11/32, 3/8, 7/16, 1/2″ – Outlet tester – Parts box – Penlight – Pliers (7): diag. cutter 4–1/4″; diag. cutter 5–1/4″; groove joint 7″; groove joint 10″; long nose 4–3/4″; long nose with cutter 6–3/4″; retaining ring, external – Pliers, locking, 5″ – Punch, center, 3/32″ – Punch, pin,(2): 1/16, 1/8″ – Rule, stainless, 6″

	– Scissors, electrician 's – Screwdrivers (12) : Phillips offset ratchet, #0 x 3″ pocket clip, #1 x 3″, #2 stubby, #2 x 4″; slotted offset ratchet, 1/8 x 3″ pocket clip, 1/8 x 8″, 3/16 x 3″, 1/4″ stubby, 1/4 x 4″, 5/16 x 6″ – Screwdrivers set, jeweler's, (7 pc.) – Screwstarter (2): Phillips magnetic; slotted magnetic – Scriber – Solder aid, fork and reamer – Solder aid, knife and brush – Solder removal tool – Soldering iron – Spring tool combination – Tape measure, 12′ – Trimpot tool – Tweezer, reverse action – Wire crimper/stripper – Wire stripper/cutter – Wrench, adjustable, 6″ – Tool case with pallets.

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